

**System Audit of the Ambient Monitoring Program of
Bay Area Air Quality Management District
November 26 - 30, 2001**

Conducted by: U.S. EPA Region IX

Final: October 22, 2003

Draft Final: May 31, 2002

Draft Revision: August 6, 2002

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1. Executive Summary

This report describes the results of the Technical System Audit (TSA) of the Ambient Monitoring Program operated by the Bay Area Air Quality Management District (BAAQMD). The System Audit was conducted November 26th - 30th, 2001 and consisted of an on-site review of the record keeping, monitor siting and instrumentation, laboratory operations, as well as interviews with key personnel, managers, staff and station operators. This review is required of the EPA Regional Office on a recurring basis and is conducted to ensure that the monitoring programs operated with Federal funding under the requirements of the Clean Air Act are producing measurements and data of good quality.

The BAAQMD conducts an ambient monitoring program of high quality, meeting or exceeding federal requirements. The District has developed a program over the years which incorporates many good practices. The TSA uncovered no significant deficiencies with the District's monitoring program. The report specifies recommendations in those aspects of the program which could be improved or revised. Some highlights based on the TSA are:

Program strengths

- The District's Quality Assurance program staff functions well and cooperatively with field operators. By avoiding what often becomes a contentious relationship, BAAQMD has a productive working relationship between the two groups in which problems can be understood and resolved.
- Field supervisors review monitoring data daily. This level of review is exceptional and EPA commends the District for this effort taken to ensure data quality.
- New operators expressed confidence in their ability to contact more experienced operators for assistance or technical support when needed.
- Critical sites (i.e. National Ambient Monitoring Stations {NAMS}: high concentration and high population exposure) are visited daily by the operators. This level of oversight ensures minimal loss of monitoring data due to instrument malfunction.
- The field audit program performs audits more frequently than is required by regulation. The auditors are independent from the monitoring staff but the two groups work well together.

- The PM_{2.5} laboratory program has been well-implemented and exceeds regulatory requirements.
- In general, the District has a strong data management program, much of it developed in-house; staff and management are committed to collecting and reporting data of good quality.
- The District has been a willing participant in numerous ambient monitoring studies as a partner with EPA and with the California Air Resources Board. These studies are ways to enhance information and knowledge about air pollution and its causes.

Significant Findings of the 2001 TSA

- BAAQMD should identify and separate the roles of a Quality Assurance Manager, Quality Assurance Officer for Laboratory Activities and Quality Assurance Officer for Monitoring Activities. Currently, the responsibilities for QA oversight are conducted in a decentralized manner.
- Federal regulatory probe siting criteria may no longer be met at the Santa Rosa, San Raphael and San Jose 4th Street stations due to airflow obstruction caused by maturing trees.
- BAAQMD does not have a uniform program for producing and archiving documentation required for data collection activities.
- The PM₁₀ Laboratory quality control system should be revised and updated.

The BAAQMD management and staff members interviewed proved knowledgeable of regulatory requirements of their activities and their relative importance to other aspects of the program. All were cooperative with the entire process. EPA wishes to thank all those staff and managers interviewed for their willing participation in the audit.

The TSA provided EPA the opportunity to become more familiar with the BAAQMD monitoring program in light of recent personnel changes at Region IX. Through our improved knowledge and familiarity with the Bay Area network, we hope to continue to work closely with the District on existing monitoring issues and on new programs, such as toxics or PM Coarse monitoring, as they develop.

2. Introduction

Federal, state, tribal and local air quality monitoring agencies all have important and inter-related roles and responsibilities in developing, operating and maintaining satisfactory air monitoring programs. The overall goal of federally-supported monitoring programs is to ensure consistent implementation of monitoring regulations across the nation and to provide data of sufficient quality to meet program objectives.

Along with having a satisfactory monitoring program, state, local and tribal agencies are responsible for implementing an appropriate quality assurance program. Further, it is the agency's responsibility to implement their quality assurance programs in all phases of the data collection process, including at the field stations, in their own laboratories as well as at any consulting and contracting laboratories which they may use to obtain data.

EPA's responsibility, under the Clean Air Act (amended 1990) includes developing the necessary tools and guidance as well as providing oversight so that our state, tribal, local partners can implement their monitoring and quality assurance programs effectively.

EPA Regional Offices have the responsibility to evaluate the capability of State, Tribal and Local monitoring programs and agency laboratories to measure and report criteria air pollutants and to determine that the monitoring programs comply with federal regulations governing the collection, analysis, validation and reporting of ambient air quality data. As part of this continuing responsibility, Region 9 conducted a Technical System Audit (TSA) of the Bay Area Air Quality Management District from November 26 - 30th 2001. This period coincides with the recommended audit duration of approximately four days for reviewing a network of 10-20 stations. In all, 14 stations were evaluated.

The scope of the system audit was to conduct an appraisal of the following monitoring program areas at BAAQMD:

- Network Design
- Laboratory Activities
- Field Operations (including station visits)
- Data Management
- Quality Assurance Procedures

The emphasis during the 2001 TSA was on the pollutants ozone and particulate matter (PM₁₀ and PM_{2.5}). For the San Francisco Bay Area, ozone and PM_{2.5} continue to be periodically measured above the NAAQS.

The EPA audit team consisted of Catherine Brown, Robert Pallarino, Periann Wood and

John Kennedy of the Air Division, Technical Support Office and Matthew Plate of the Office of Quality Assurance in the Policy and Management Division. The team followed the procedures of EPA's Quality Assurance Manual Volume II for Technical Systems Audits.

BAAQMD Program Description

The Bay Area Air Quality Management District has been in existence for more than 40 years and has primary responsibility for ensuring the health and welfare of citizens of the San Francisco Bay Area under the Clean Air Act of 1970 and its Amendments of 1990. The District conducts ambient air quality monitoring in support of its role in developing and enforcing air pollution control regulations. BAAQMD is an independent agency with more than 300 employees, governed by a 21-member Board of Directors. The Board is made up of publicly-elected officials apportioned according to the population of the represented county.

Members of the BAAQMD participating or interviewed as part of the TSA are:

Gary Kendall	Director of Technical Services Division
Avi Okin	Meteorology Data Analysis/Air Monitoring Manager
Jim Hesson	Air Quality Laboratory Services Manager
Stan Yamaichi	Supervising Air Quality Instrument Specialist
Dan Zucker	Supervising Air Quality Instrument Specialist
Graham Scovell	Air Quality Instrument Specialist
Tracy Daub	Air Quality Chemist
Bob Schusteritsch	Air Quality Instrument Specialist
Garry Smith	Air Quality Instrument Specialist
Tony Larsen	Air Quality Instrument Specialist
John England	Air Quality Instrument Specialist
Gary Zoppo	Air Quality Instrument Specialist
Roland Wiebe	Air Quality Instrument Specialist
Bob Franicevich	Air Quality Instrument Specialist

Each program area reviewed has a separate chapter in the report. The final chapter, Chapter 9, provides a summarized list of all EPA's recommendations to assist the District in organizing its response to the audit through development of a corrective action plan.

As a note, Avi Okin, the long-time Meteorology and Monitoring Manager has retired from the District after spending much of his career dedicated to air monitoring in the San Francisco Bay Area. EPA commends Mr. Okin for his numerous and significant contributions to the quality of the monitoring program, in the San Francisco Bay Area and nationally.

3. General Program Findings

3.1 Finding: BAAQMD has not identified a central QA manager who oversees and coordinates quality assurance for data collection activities.

Discussion: Currently many of the functions normally performed by a QA manager are being performed in a decentralized manner. The California Air Resources Board (ARB), the Laboratory Manager, the Monitoring Manager, the Audit Group Supervisor, and other members of the monitoring group are performing “QA Manager” functions. These functions have not been well coordinated, and no individual(s) have been delegated QA “sign off” authority. In general, each organization which collects monitoring data should have a QA Manager, independent of monitoring operations, who provides QA program development and oversight (quality management plan development, quality assurance project plan and standard operating procedure review and approval, oversight and management of QA corrective actions, internal technical system audits and other system evaluations, and coordination with USEPA in regards to quality assurance). It is conceivable that BAAQMD might retain a decentralized quality management structure. This would involve regular coordination between BAAQMDs QA “workgroup,” and formal delegation of QA management functions.

Recommendation: Assign an individual or individual(s) to act as the BAAQMD QA Manager.

3.2 Finding: The BAAQMD does not have a Quality Management Plan or updated Quality Assurance Procedures/Plans for pollutants other than PM2.5.

Discussion: BAAQMD currently uses a years-old QA Manual for pollutants other than PM2.5. Generally monitoring agency QA documents should be reviewed annually and any necessary changes should be incorporated and submitted to USEPA for review. The Audit Group Supervisor has been asked to update the QA Manual used by BAAQMD and has compiled some updated Standard Operating Procedure (SOPs) to include in this revision. USEPA grant recipients, who collect environmental measurements, are required to develop a Quality Management Plan (QA/R2) and Quality Assurance Project Plans(QA/R5). For pollutants other than PM2.5, USEPA Region 9 has been flexible on the format of QA documents submitted as long as program, QA/R2, and QA/R5 requirements are met. However, BAAQMD may want to consider revising the QA Manual into the QMP and QAPP format, as regulatory and guidance changes currently underway at OAQPS may specifically

reference QA/R2 and QA/R5.

Recommendation: Update the QA Manual to be consistent with current USEPA guidance and current BAAQMD practices.

3.3 Finding: BAAQMD does not have a formal QA corrective action process.

Discussion: EPA quality management standards (EPA QA/R-2, Quality Improvement Section) require that management and staff “ensure that conditions adverse to quality are” prevented, identified promptly, fully defined, corrected, prevented from reoccurrence, and documented as corrective actions which are tracked to closure. BAAQMD needs to implement a formal corrective action process that meet these requirements. BAAQMD QA management staff must be an integral part of any corrective action process.

Recommendation: BAAQMD should develop a formal district-wide corrective action process.

3.4 Finding: BAAQMD does not have a uniform program for producing and archiving documentation required for data collection activities.

Discussion: BAAQMD must have a record keeping policy to ensure documentation is appropriate, defensible, tracked, and retained for the appropriate length of time. During the audit, the following deficiencies were noted which are indicative of the lack of an appropriate record keeping policy:

- SOPs and logbooks were not controlled copies.
- Staff may use identification numbers in place of signatures or initials (on documents that may constitute legal records).
- Logbooks/worksheets do not have a signature block for a second level reviewer.
- Many logbook entries are not made in indelible ink (in some cases pencil was used).
- Changes are not routinely single-line crossed out, initialed, and dated; use of “obliterations,” “write overs,” and white out were observed.
- The period records would be retained and the document/logbook archive process was not clearly established or consistently applied across stations, laboratories, offices.

Recommendation: BAAQMD should put in place a consistent record keeping process in which records are traceable and legally defensible.

3.5 Finding: BAAQMD has experienced recurring personnel shortages and exceptional difficulty in filling vacancies.

Discussion: During the 1990's, the District experienced staff vacancies for field operators which it continues to have difficulty filling permanently. Finding qualified technical staff in the SF Bay Area job market has proven difficult. It is likely that the high cost of living in San Francisco Bay Area also plays a role. It is apparent that the District will continue to experience hiring difficulties for the foreseeable future.

Recommendation: The District should pursue development of technologies which can relieve workload burdens for station operators. Such technologies could include the streamlining of data logging, validation and storage and/or the wider use of the Internet to transfer and communicate data and information.

Comment: *The BAAQMD Air Monitoring Program staffing peaked at 29 FTEs. Due to chronic revenue shortages in the 1990s, Program staffing was reduced by attrition to 24 FTEs in 1993, and to a low of 19 FTEs in 2000. From 1993 through 2002 the vacancy rate for the Air Monitoring Program ranged from 10% to 25%. During that period both the size (number of stations) and complexity of the air monitoring network increased, with the addition of PM_{2.5} monitoring, continuous PM monitoring, additional toxics monitoring, Children's Environmental Health Program monitoring, and numerous special monitoring projects described in 3.6. As a result of declining resources and high vacancy rates, available resources were focused on maintaining operations and participating in important special monitoring projects.*

Again due to chronic revenue shortages in the 1990s, the Laboratory Program staffing was reduced from 8 FTEs to 7 FTEs in 1996. The vacancy rate was 29% or 2 FTEs from 1998 through 2001. As of July 1, 2002, there is one vacancy.

Current staffing for the Air Monitoring Program is 21 FTEs. For the first time since 1992, on June 3, 2002, the Program had 20 filled positions. However, at least 6 of the 20 current staff members require training or additional training to become proficient. The Air Monitoring Manager position is vacant, and is not expected to be filled until late 2002.

3.6 Finding: BAAQMD has historically been a willing partner in numerous special monitoring studies with EPA and with the California Air Resources Board.

Discussion: In addition to implementing the regulatory monitoring of criteria pollutants for the

San Francisco Bay Area, the District has supported numerous monitoring projects of widely varying extent and duration. In some cases, the studies extended beyond the borders of the District. Recent examples include: the Central California Air Quality Study (CCAQS), the Air Resources Board's SB-25 Children's Environmental Health Program, the ARB's ongoing Toxics Monitoring Program and the joint EPA-ARB-BAAQMD dioxin investigation. The District's willingness to take a central role in new, investigative, often difficult monitoring projects shows a commitment to air quality improvement.

Recommendation: Continue to support the investigation into new methods, new pollutants and improved understanding of air quality when possible. The District is commended for their efforts.

Comment: *Since 1992, in addition to the special monitoring projects listed above, the Technical Division has conducted or participated in numerous local summer ozone and winter PM studies, motor vehicle emission measurements in the Caldecott Tunnel, Bay Area PM10 Study, CCOS and CRPAQS (parts of CCAQS), etc.*

4. Network Management

The BAAQMD criteria pollutant monitoring network consists of 27 separate stations throughout the six-county San Francisco Bay Area (Alameda, Contra Costa, Marin, San Francisco, San Mateo and Santa Clara counties) and in parts of Solano, Sonoma and Napa counties. The District monitors for all the criteria pollutants (except lead), carries out PM10 and PM2.5 weighings, conducts VOC, metals and toxics analyses in their laboratory and reports the data directly to EPA's Aerometric Information Retrieval System (AIRS).

The Districts' organizational chart is attached (Appendix C). EPA's Office of Air Quality Planning and Standards (OAQPS) has identified key positions¹ for an ambient monitoring program. For BAAQMD, the individuals currently serving in those roles include:

Technical Operations Director:	Gary Kendall
SLAMS Network Manager:	Avi Okin
Quality Assurance Officer:	none identified
Field Operations Supervisor:	Avi Okin
Laboratory Supervisor:	Jim Hesson
Data Management Supervisor:	Avi Okin

A significant change to the District's program comes with the retirement of long-time Monitoring and Meteorology Manager, Avi Okin. Mr. Okin has been key to the Districts' operations for Field Operation Supervision, NAMS/SLAMS Network Management and Data Management Supervision, all positions of responsibility in the ambient monitoring program. These roles have been reassigned within the District. BAAQMD has already appointed a temporary replacement for the monitoring program, Mark Stoelting, and plans to fill the position permanently in the coming year.

A summary of the District's monitoring by pollutant and monitor type is listed in Table 4.1 below.

¹ Quality Assurance Handbook for Air Pollution Measurement Systems: Vol II: Part 1, Appendix 15 Sect 2 August 1998.

Table 4.1 Number of Monitors Operated by BAAQMD

Monitor Type	Carbon Dioxide	Ozone	PM ₁₀	PM _{2.5}	Sulfur Dioxide	Nitrogen Dioxide	Total
NAMS	4	4	7	0	2	4	21
SLAMS	12	18	5	9	7	10	61
SPM	0	0	1	0	0	0	1
Total	16	22	13	9	9	14	83

Source: "BAAQMD Air Monitoring Network Report 2000 - 2001"; A. Okin, G. Kendall

The BAAQMD monitoring network is adequate to measure for all the criteria pollutants and PM_{2.5}. The pollutants which continue to be measured above the NAAQS in the Bay Area are ozone (both 1-hour and 8-hour) and PM_{2.5}. At the time of the TSA, the District was in nonattainment for the 1-hour ozone standard. Nationally, designations for 8-hour ozone and PM_{2.5} standards have not yet been made and thus, the District's status is not established for those pollutants. Based on data already reported to AIRS by the District, the Bay Area may not be in compliance with the new ozone and PM_{2.5} standards.

4.1 Finding: The BAAQMD's Annual NAMS/SLAMS Report continues to provide a thorough network description, a discussion of known and expected changes to the network and long-term trend information.

Discussion: Through its annual network report, the District demonstrates thorough knowledge and understanding of the 40 CFR Part 58 regulations relating to ambient monitoring. As part of the development of the National Monitoring Strategy, EPA has assessed monitoring networks nationwide with the intention of evaluating the relative importance of individual sites. Based on the National Assessment, EPA is recommending that states and local districts do their own assessments on a 3-5 year cycle. The District's annual report already provides what could become the basis of such an assessment.

Recommendation: Continue to generate an Annual NAMS/SLAMS Report which includes data analysis and network assessment.

4.2 Finding: The District is facing eviction from the long-term SLAMS/NAMS monitoring site at San Jose 4th Street.

Discussion: The station at San Jose 4th Street has operated for 30+ years providing valuable trend information for all the criteria pollutants. It is a NAMS station for CO

(microscale), NO₂ and PM₁₀. Historically, PM₁₀ levels there have been the highest in the entire Bay Area, though not currently exceeding the NAAQS. The site also has served as an air toxics monitoring location for the past 15 years and is of interest to the National Toxics Steering Committee as a national trends site. The site is one of 7 dioxin monitoring locations in the Bay Area. It is an important site in the District's network. Relocation within the vicinity, continuing to monitor an equivalent air mass, will allow the site to continue to compare to the historic site for trend purposes. It would also allow continued use of the same AIRS site identification number for all pollutants monitored there with the possible exception of microscale CO. Moving the microscale CO from the roadway currently being sampled (4th Street) would require a change in site ID. A change to the San Jose CMSA's microscale CO will have to be addressed.

Recommendation: The District should relocate the San Jose 4th Street station as quickly as possible and within the vicinity of the current site, to continue monitoring the equivalent air mass.

4.3 Finding: The shopping center where the District's San Pablo station is located is being redeveloped, necessitating a change in location for that station.

Discussion: The San Pablo station is designated as the NAMS site for SO₂, SLAMS for NO₂, CO and Ozone. This site has been in operation since 1997 and has shown no exceedances of the NAAQS for those pollutants.

Recommendation: Consider discontinuing the operation of the San Pablo site and selecting an alternative SO₂ NAMS from existing stations.

4.4 Finding During the audit, it was learned that there will be reconstruction at the Los Gatos site; for the duration of construction, the ozone monitor would not operate.

Discussion: The fire station where the Los Gatos ozone monitor is housed will undergo reconstruction and expansion beginning possibly March 2002 and lasting several months. For the period of construction, ozone would not be measured at the site. This interruption in monitoring is beyond the control of the District. As a NAMS station, monitoring urban-scale for the maximum concentration of ozone, this is an important site in the network. If the loss of ozone monitoring data extends into the summer months, it could potentially affect the calculation of ozone 8-hour design value for the site.

Recommendation: When reconstruction occurs, return the Los Gatos site to operation as soon as possible.

4.5 Finding: The District has attained the national CO standard for at least 10 years but continues to operate 16 CO monitoring sites.

Discussion: In light of stagnant federal funding for air monitoring, the District may find through periodic assessment of its entire network that savings could be realized by discontinuing a number of monitoring sites for pollutants for which it has attained the national standard.

Recommendation: As part of a periodic assessment of the entire network, the District should consider terminating some CO monitoring in areas measuring well below the NAAQS.

4.6 Finding: District-wide monitoring for SO₂ shows maximum levels at less than 10% of the NAAQS. Monitoring at 9 sites is still being carried out.

Discussion: Trends data shows that San Francisco Bay Area experiences SO₂ levels well below the national standard. An assessment of the network may show the opportunity to reduce the number of sites with a resultant cost savings.

Recommendation: As part of a periodic assessment of the entire network, the District could consider terminating some or most SO₂ monitoring in those areas reading well below the NAAQS.

5. Laboratory Activities

General Laboratory Findings

The District's laboratory operations are under the immediate supervision of Jim Hesson, who reports to the Technical Director, Gary Kendall.

Findings one through six demonstrate that the laboratory quality system should include more formal procedures to ensure that data produced is of known and documented quality. District staff and management are clearly aware of the importance of such procedures. It should be noted that, due to implementation of a detailed PM_{2.5} QAPP and oversight from the ARB QA group, the PM_{2.5} program is only minimally impacted by these deficiencies. Findings seven through nine are minor deficiencies which are easily correctable.

5.1 Finding: There is not a QAPP or Laboratory QA Manual detailing data quality operations for the BAAQMD laboratory. Note, for PM_{2.5} much of these operations are covered by the PM_{2.5} QAPP.

Discussion: A QA Manual (or equivalent document) should document laboratory operations such as organizational structure, quality assurance management, data review, training and certification, laboratory corrective action, quality control procedures, control of standard operating procedures, record keeping, and analytical method validation.

Recommendation: Develop and implement a laboratory QA Manual (or equivalent document) to cover all aspects of laboratory operations.

5.2 Finding: There is no internal laboratory or external quality assurance officer coordinating the laboratory QA/QC program.

Discussion: If BAAQMD continues to operate a decentralized QA program, the laboratory must have a QA officer. If BAAQMD restructures its QA program (See General Finding 3.1) the QA manager could perform QA oversight of routine laboratory operations. However, the preferred organizational structure would be for the laboratory to have a QA Officer to perform routine QA/QC functions for the laboratory with the BAAQMD QA Manager interacting with the laboratory to review and approve the laboratory and QA Manual and to address significant corrective actions. When a laboratory is responsible for a significant number of complex analyses, it is strongly recommended that an individual be assigned quality assurance responsibilities for laboratory operations.

Recommendation: Assign an individual as QA officer, other than the laboratory manager, to be responsible for laboratory quality assurance activities.

5.3 Finding: The laboratory does not have a formal, documented corrective action process.

Discussion: A formal corrective action process identifies the actions that will be taken when a problem is identified. Corrective action may be initiated based on problems with laboratory equipment, instruments, supplies, and/or methods which could potentially impact data quality or defensibility. The intent of a formal corrective action process is to resolve, to the satisfaction of an organization's quality managers, the data quality problem identified.

Recommendation: Define the laboratory corrective action process in the laboratory QA Manual (Laboratory Finding 5.1) and implement it.

5.4 Finding: Laboratory Standard Operating Procedures (SOPs) and logbooks are not part of a document control system (See General Finding 3.4) An additional concern, the SOPs used have not been marked with a version number or a date of issuance.

Discussion: As noted in General Finding 3.4, control of documents is important to demonstrate data quality and defensibility.

Recommendation: Develop a laboratory record keeping procedure consistent with General Finding 3.4. Additionally, the laboratory should, immediately, add issuance dates and/or version numbers to all SOPs.

5.5 Finding: There is not an SOP for the data base program used for data acquisition and storage.

Discussion: The laboratory relies on the analyst's memory and on-the-job training to implement the data base. The complexity of this database is such that there should be an SOP for the analysts to reference. For the data acquisition process to be transparent and defensible, if audited by an outside party, there must be an SOP.

Recommendation: Develop an SOP for the laboratory data acquisition data base program.

5.6 Finding: The laboratory does not use control charts to assess monitor performance.

Discussion: Control charts track data quality and identify when proactive corrective action may be needed, in addition to providing a benchmark for continuous quality

improvement. The QA handbook, Volume II, section 12 provides guidance on constructing and using control charts.

Recommendation: EPA strongly recommends that control charts be used to monitor laboratory quality control checks.

5.7 Finding: Some events and activities occurring in or relating to the PM weigh room are not being documented.

Discussion: Weigh room events, such as ventilation system failures and visitors, may be important in the data interpretation process.

Recommendation: A logbook should be established which tracks weigh room activities.

5.8 Finding: Expiration and receipt dates for filters and supplies are not tracked.

Discussion: In order to ensure that supplies are used in the order received and within their shelf life, receipt and/or expiration dates should be tracked. Where possible supplies should be labeled as to when they were received and/or when they expire. This information may also be helpful in resolving corrective actions associated with substandard supplies.

Recommendation: Set up a tracking system for laboratory supplies.

5.9 Finding: The temperature of the freezer used for sample storage is not logged.

Discussion: Temperature records are important in documenting filter integrity during storage. Because the freezer in question is primarily used for archive filters and is not accessed on a daily basis, it would be acceptable to log the temperature each day or whenever the freezer is accessed, whichever is less frequent. (Normally, sample freezers' temperatures must be recorded daily. However, due to the nature of the freezer being used, daily opening and closing may impact sample integrity more than not having a daily temperature record). Optimally the freezer should have an externally mounted thermometer that could be recorded daily or logged continuously.

Recommendation: Set up a procedure for routinely documenting the laboratory sample storage freezer temperature.

PM2.5 Laboratory Procedures

The BAAQMD PM2.5 laboratory is well run and the analytical and quality assurance procedures for PM2.5 are appropriate and well executed. A number of minor, easily correctable, deficiencies are noted below.

5.10 Finding: The laboratory was not using and had not reviewed the data validation guidance issued by OAQPS, “PM2.5 Data Validation Template.”

Discussion: The “PM2.5 Data Validation Template” states the regulatory requirements that must be adhered to in the PM2.5 data validation process as well as giving a framework for evaluation of other quality control issues. BAAQMD laboratory staff claimed that their validation process was consistent with this template and the limited review of data conducted did not reveal any discrepancies.

Recommendation: The laboratory should adopt the OAQPS “PM2.5 Data Validation Template” and review their PM2.5 validation process to ensure consistency with this template.

5.11 Finding: The serial numbers of the weights used as working standards are not recorded in either the daily calibration logs or the logs used to make comparisons to the primary standards.

Discussion: It is important to document which weight was used to verify balance performance. This is especially important for the BAAQMD PM2.5 laboratory because two sets of working standards are used in routine operations. If one of these weights are damaged, it may be important to have this information to evaluate what data may be impacted.

Recommendation: Include the weight serial numbers, or other unique identifier, in each logbook entry.

5.12 Finding: The shipping blocks used to transport filters to and from the field are made of aluminum and there is aluminum powder present on the blocks which is a potential source of contamination.

Discussion: BAAQMD has not noted a blank contamination problem recently, so it seems unlikely that this powder is having any impact on data quality. However, there is potential that this may be a source of filter contamination in the future.

Recommendation: Evaluate if these blocks can be cleaned. If aluminum contamination is

found to be a source of sample contamination in the future, discontinue use of these blocks (antistatic bags can also be used for sample handling).

5.13 Finding: The laboratory is not checking the temperature log of each sample shipment unless there is reason to believe a temperature excursion occurred. Additionally, the temperature loggers used do not undergo routine calibration checks.

Discussion: Sample integrity in shipping must be demonstrated. The containers used are well insulated and BAAQMD did not notice problems with shipping temperatures early in the PM_{2.5} monitoring program when temperatures were routinely monitored. However, samples often spend multiple days in route to the laboratory.

Recommendation: Compare the temperature loggers to a certified temperature standard at least annually. Record the temperatures logged for each shipment or provide sufficient documentation of studies that demonstrate that the criteria used for checking temperature loggers is adequate to preserve sample integrity.

5.14 Finding: The antistatic polonium (Po) strips used do not have an expiration date.

Discussion: Po strips used for static control have a limited useful life before they begin to lose effectiveness (See Laboratory General Finding 5.8).

Recommendation: Set a reasonable expiration date for the type of Po strips used.

5.15 Finding: Samples are disposed of after about one year. Sample disposal is not tracked in a logbook.

Discussion: The laboratory needs to maintain and track which samples it has in its possession. Sample disposal is an important part of the sample custody process.

Recommendation: Sample disposal should be recorded in a logbook.

5.16 Finding: Storage space for PM_{2.5} filters is limited and crowded, and there are no criteria for archiving samples for more than one year.

Discussion: The freezer used for PM_{2.5} storage was nearly full. In order to fit the samples into the freezer, samples were only being stored for the minimum time from collection, one year. It is conceivable that under some circumstances samples may need to be archived for a longer duration.

Recommendation: The laboratory should consider an alternative storage space for filter archive. BAAQMD should develop options or additional storage facilities for storing filters for over one year.

5.17 Finding: The laboratory does not control PM_{2.5} samples in well-defined batches.

Discussion: Sample batching is useful for tracking QC sample performance and associating QC samples with specific field samples. Sample batches with QC problems are easily tracked through the data validation and corrective action processes.

Recommendation: The laboratory should consider batching samples as a part of the QA process.

5.18 Finding: Temperature and relative humidity excursions were noted on the weigh room strip charts. No explanation of these excursions was documented.

Discussion: It is important to document events that may have an impact on data quality. Even when no sample results are impacted, excursions may indicate a systematic problem with the HVAC system. Documentation should be included on the strip chart and in a logbook. This documentation should note if any sample results were impacted.

Recommendation: Explain weigh room temperature and relative humidity excursions on the strip charts and/or in a logbook.

PM₁₀ Laboratory Operations

PM₁₀ filter weighing was transferred to the laboratory staff in 1996. While the laboratory staff has made some improvements, the PM₁₀ laboratory operations had significant deficiencies. Several major findings are noted below. It is recommended that BAAQMD review the PM₁₀ program to ensure it complies with the most recent USEPA guidance and good laboratory practices.

5.19 Finding: The SOP used for PM₁₀ is limited to an outline for the analytical procedure.

Discussion: Analytical method SOPs should include sufficient information to independently replicate the procedures used. The SOP should include descriptions of equipment, supplies, quality assurance, corrective action, detailed procedures, and etc.

Recommendation: Develop a more complete SOP based on the most recent guidance for PM₁₀.

5.20 Finding: Insufficient Quality Controls and QC criteria have been established for the PM10 filter weighing process.

Discussion: Laboratory QC checks, such as blanks duplicate weighing are not conducted. Other QC checks such as balance calibration checks have no established QC criteria.

Recommendation: Based on PM10 guidance documents and good laboratory practices establish more rigorous QC checks for the PM10 weighing laboratory.

5.21 Finding: The weights used to verify the PM10 balance are not checked against certified weights.

Discussion: The laboratory has no record of the PM10 weight being certified. It is required that these mass standards be regularly certified.

Recommendation: The laboratory must setup a schedule for certification of these weights.

Good Laboratory Practices

5.22 Finding: The BAAQMD PM2.5 laboratory program has been audited on a regular basis by the ARB Quality Assurance staff since its inception. The finding from these audits and the BAAQMD laboratory's proactive corrective actions have significantly improved the quality of PM2.5 data.

5.23 Finding: The laboratory archives PM2.5 data in an organized and logical manner.

5.24 Finding: The PM2.5 filter weights are transferred directly to the data system and verified by the analyst. This process reduces the potential for analyst errors.

5.25 Finding: The laboratory is doing both trip blanks and field blanks for PM2.5. Trip blanks were an important tool to diagnose problems at the inception of the PM2.5 program, when blank contamination was a problem. Because trip blanks are a "value added" part of BAAQMD's PM2.5 program trip blanks frequency can be adjusted based on program needs.

5.26 Finding: BAAQMD submits quarterly reports to ARB for the PM2.5 program. These are a valuable QA oversight tool and reflect constructive cooperation between BAAQMD and the ARB.

6. Field Operations

Field operations have been under the supervision of Avi Okin, Monitoring Manager. The operators report directly to one of two Senior Technical Supervisors, Tom Conwell covering North Counties and Stan Yamaichi covering South Counties. These supervisors provide hands-on technical support and training to the operators, as well as having primary responsibility to review data and calibrate the instruments.

Station operators have responsibility for day-to-day operation of between 2 and 6 monitoring stations, including ensuring the operation and maintenance of the station and all instruments, review of zero/span checks, perform flow checks and perform instrument calibrations. Quarterly audits are performed by a separate team at the District and by the ARB for those sites considered part of the state's network on a random schedule.

6.1 Finding The material of the probe at the Los Gatos station does not meet Appendix E requirements.

Discussion: The funnel at the opening is of an undetermined plastic material.

Recommendation: Following reconstruction of the fire station, ensure that the probe is made of glass or teflon its entire length.

6.2 Finding: The monitoring objectives of some stations may be impacted by changes in nearby land use and or land cover.

Discussion: Three stations, San Jose 4th, San Raphael and Santa Rosa, were identified as having airflow possibly obstructed by maturing trees at the sites. Also, potentially increased ADT on nearby roadways due to population growth and development in the vicinity were noted (Concord). Buildings constructed nearby after a site has been established may also be obstructing airflow (San Jose and Santa Rosa).

Recommendation: Periodically review and evaluate the monitoring objectives and spatial scales for monitoring stations in the network. Attempt to resolve siting issues caused by nearby trees and buildings that obstruct air flow. Relocate probes or sites if necessary.

6.3 Finding: The condition and use of field station SOPs was inconsistent.

Discussion: Field station SOPs for monitoring operations were not consistently used by operators, were not consistently dated, in some cases were not recently updated

and some operators were not familiar with the content of the SOPs.

Recommendation: Standardize field SOPs and have operators become familiar with the methods.

6.4 Finding: Monitoring station logbooks are not uniformly maintained.

Discussion: Station logbooks are not completely maintained with all activities at the station, are not filled out using indelible ink, are not always signed by the operator and are not archived as part of the legal record. Some station logbooks are spiral bound which allows removal of pages and is not optimal.

Recommendation: Standardize the use of logbooks at all stations using legally defensible record-keeping practices.

6.5 Finding: Manifold maintenance is not logged by station operators and may not be done at some sites.

Discussion: The cleaning of the manifold is an EPA-recommended procedure about which the District expressed disagreement. Given that the routine operating procedures include a high concentration ozone span, introduced near the front of the manifold either daily or every other day, it is not likely that reactive sites could occur inside the manifold. Also, the District performs well on the through-the-probe audits conducted by ARB. Both indicate the condition of the manifold.

Recommendation: The District should include installation, maintenance or changes affecting the manifold in the station logbook.

6.6 Finding: The station data for NO_x is not being logged.

Discussion: NO_x data is valuable in diagnostically assessing the monitors' performance. This data could also be used by the site operators to help resolve instrument problems (corrective actions). Currently recording of NO_x data is limited by the data acquisition hardware at many sites. However, BAAQMD plans to upgrade this hardware in the near future.

Recommendation: Wherever possible BAAQMD should start recording NO_x data to be used for diagnostic purposes.

6.7 Finding: Access to training for station operators is limited to on-the-job training, ARB

courses, introductory EPA basic courses.

Discussion: Station operators expressed interest in the availability of training through EPA or through instrument manufacturers on topics such as QA procedures and instrument maintenance.

Recommendation: District management should support adequate or additional training for monitoring staff as needed: for new staff to learn correct air monitoring practices and methods early and for experienced staff to stay abreast of new developments.

6.8 Finding: District personnel expressed concern about a specific vendor's PM2.5 firmware.

Discussion: The PM2.5 vendor, Andersen, has had to issue numerous versions of its firmware for the sequential monitor used by the District. This has created additional work for the station operators and has resulted in some lost samples.

Recommendation: EPA will refer these concerns to its Office of Air Quality Planning and Standards (OAQPS) for resolution under the national contract.

6.9 Finding: Cylinders of calibration gases are not logged or dated at some monitoring stations.

Discussion: 40 CFR Part 58 requires using standard reference materials (SRMs) or gaseous standards traceable to SRMs for calibrating and auditing ambient monitoring systems. Certification periods for compressed gas calibration standards in aluminum cylinders range between 24 and 36 months ² depending on concentration. Calibration gases are typically certified by the vendor for 2 years. Some cylinders were observed exceeding the vendor's certification date. The District believes that the cylinder gases are stable over longer periods and are expensive to purchase. Operators are using pressure reading on the cylinder as an indicator of the need for replacement.

Recommendation: Log calibration gas cylinders in station logbook when installed at the site and use age as the indicator of need for replacement.

² EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards, Sept 1997

Good Field Practices

6.10 Finding: All operators interviewed demonstrated knowledge and understanding of regulatory criteria, instrument performance and monitoring procedures.

6.11 Finding: Written SOPs state performance criteria of $\pm 15\%$ but operators use much stricter limits (± 2 or 3%)

7. Data Management

Data is logged at each monitoring station by computer with strip chart backup. Monitoring data is telemetered to the District office from each site once per day with the exception of ozone which is retrieved hourly for the national mapping project. Station operators review and evaluate strip chart recordings and compare the information to the data loggers, checking the zero and span results to ensure the instruments have operated within established limits. For the continuous pollutants, the District allows $\pm 3\%$ of the set point. The Senior Supervising Technician reviews the data daily. The precision and accuracy data is reviewed by Nancy Balberan with the final review and entry into AIRS by the Monitoring and Meteorology Manager.

BAAQMD has developed an in-house data management system which allows review and validation of their data, quality control review by supervisors, conversion to AIRS format and upload to the AIRS database. The set of programs generated in-house is not formally documented. The District has a record of being timely with data submittals to AIRS and responsive to changes mandated by the new system. Data is quality-control checked using Voyageur software. The procedures for auditing data quality were not directly reviewed for this audit.

During the TSA, the District described plans underway to revise their entire data system, from data loggers to AIRS reporting. The District has converted to the data output format needed for the re-engineered AIRS, in preparation for when the new system is made available to users. In light of the planned changes to their entire data system and the coming changes the new AIRS necessitates, it is recommended that the District's data system be the focus of a future TSA.

7.1 Finding: Training for the new AIRS data system was specifically requested by the District.

Discussion: EPA recognizes the importance of AIRS to both the national and the District's programs. EPA Region 9 held training for the new AIRS system the week following the TSA. Bay area personnel were able to attend. However, the new AIRS system was not immediately available for use to reinforce the training.

Recommendation: EPA Region 9 should continue to support training on the new AIRS system, particularly during the startup period.

8. Quality Assurance Program

General Program

The Quality Assurance Audit Team is supervised by Dan Zucker, who reports to the Monitoring and Meteorology Manager.

8.1. Finding Changes in BAAQMD practices may not result in changes to SOPs and updated SOPs have not resulted into QA Manual changes. (General Finding 2)

Discussion BAAQMD should have a well documented and a consistent monitoring program. Having SOPs that are updated, included in the QA Manual or QAPP, and controlled is important to establish such a program.

Recommendation: Review SOPs to ensure that they are consistent with current practices and updated as necessary.

8.2. Finding AQDAs issued by ARB are not routinely shared with the audit group & others inside BAAQMD.

Discussion: Because AQDA may indicate as systematic deficiency with the BAAQMD monitoring program they should be distributed to all parties involve in collection of similar data. Additionally, the audit group should be involved with follow-up to ARB AQDAs.

Recommendation: Create a process to more widely distribute AQDAs and to implement more comprehensive follow-up and corrective actions when an AQDA is issued.

Data Tracking

The following Data Points were tracked for PM2.5. Mathew Plate examined archived “raw” laboratory data, laboratory data base data, laboratory logbooks, archived filters, flow audit data.

<u>Site</u>	<u>Date</u>	<u>Filter ID</u>	<u>Flow Audit Date</u>
San Francisco	1/18/01	5452	2/15/01
San Francisco	1/19/01	5453	2/15/01
San Francisco	1/20/01	5454	2/15/01
San Francisco	1/21/01	5497	2/15/01

San Jose - Tully Road	1/8/01	5175	2/27/01
San Jose - Tully Road	1/21/01	5459	2/27/01
San Jose - Tully Road	1/22/01	5459	2/27/01

All the information requested was readily available and no significant discrepancies or anomalies were found in this data set. As noted in General Finding 3, logbooks are not controlled copies, signing and intialing of documents was not adequate, and indelible ink was not exclusively used. Additionally, laboratory lot blank QC data applicable to CY2000 and CY2001 was not archived with the CY2001 data.

Mathew Plate also tracked several other randomly selected PM_{2.5} data points at the laboratory, and reviewed the multi-parameter field audit data for the Livermore site conducted on 9/6/01.

Field Audit Program

8.3. Finding: The Field Audit Group does not adequately document certifications and internal checks of their audit standards.

Discussion: There is no central logbook to document certifications and checks of audit equipment. The audit group conducts a significant amount of cross checking between audit and primary standards which are not documented. The zero air scrubber is checked quarterly to verify performance, but no documentation of zero air scrubber performance is recorded.

Recommendation: Centralize documentation of audit standard checks and document all cross checks performed.

8.4. Finding: There is no formal audit failure report or a corrective action procedure. Additionally, the current warning and control limits used for determining audit compliance are not formalized.

Discussion: In order to ensure audit failures are tracked and corrected a formal process needs to be established (see General Finding 4). BAAQMD is currently using a 5% criteria as warning limit to indicate instrument problems, and control limits established in the QA Manual are also used.

Recommendation: Set up a formal audit reporting process which includes well-defined warning and control limits.

8.5. Finding: The audit criteria are not directly based on +/- 20% at the 95% confidence

interval, and the data uncertainty at the 95% confidence interval is not tracked quarterly.

Discussion: The required Federal QC criterion³ for QA audits is statistically derived from all audits performed in a given quarter. This statistic is available in AIRS from the District's quarterly submittals. From this criterion it is recommended that agencies develop a simple QC criterion for individual audits. BAAQMD uses +/- 5% but does not base this on the Federal criterion. Additionally, BAAQMD does not calculate and track the Federal criterion and issue quarterly audit reports. These would be internal reports to specify corrective action to remove system bias. For audits conducted by the ARB 20% for the 95% confidence level is tracked, however due to the limited number of audits conducted this evaluation is not statistically significant.

Recommendation: Create audit warning and control limits based on the federal criteria, and track audit results quarterly for compliance with the federal criteria.

8.6. Finding: The field audit SOPs are not comprehensive.

Discussion: SOPs should include sufficient information to independently replicate the procedures used. The SOP should include descriptions of equipment, supplies, quality assurance, corrective action, detailed procedures, and etc.

Recommendation: Update the field audit SOPs.

8.7. Finding Audit equipment certification documentation is not routinely available in the field.

Discussion: The field auditor must be able to demonstrate, and verify certification of audit equipment, each time an audit is conducted. To do this either a copy of the audit equipment certification should be available in the field or the audit equipment should be labeled with the certification information including certification date and an authorized signature.

Recommendation: Institute a policy that the field auditors bring verification of audit equipment certification into the field.

8.8. Finding: The field auditors do not routinely make an entry into the station logbook.

³ 40 CFR Part 58 Sections 3.2 and 5.2.

Discussion: The site logbooks are important documents which verify what occurred at each field site on a given day. BAAQMD does routinely document their audits in the instrument logbooks and the site stripchart. However, audits should also be documented in the station logbook.

Recommendation: Institute a policy that auditors must document site visits and audits in the station logbooks.

8.9. Finding: The gas standards used for audits have a short “shelf life.”

Discussion: The audit gas standards were expired at the time the audit was conducted. In the auditor’s opinion this was primarily due to the short working life of the standards used. The audit group was in a position where audits could not be scheduled until new standards could be ordered and delivered by the standard vender.

Recommendation: The audit section supervisor has arranged to change the standard concentration blend to extend to working life of the standard mix.

8.10. Finding: The BAAQMD audit group noted that there have been problems implementing the National Performance Audit Program (NPAP) audits.

Discussion: BAAQMD has had problems with the audit devices provided by EPA and the manner in which results are reported. EPA is currently attempting to redesign the NPAP.

Recommendation: EPA Region 9 will forward NPAP concerns to our OAQPS counterparts.

Good Practices

8.11. Finding: The BAAQMD audit group does extensive cross checking of audit standards.

8.12. Finding: The audit and monitoring groups work cooperatively to resolve data quality issues.

8.13. Finding: The NPAP audits are conducted by audit program staff rather than site operators. This added level of NPAP audit independence increases the credibility of the program.

9. Summary of Recommendations

General Program Findings

- 3.1** Assign an individual or individual(s) to act as the BAAQMD QA Manager.
- 3.2** Update the QA Manual to be consistent with current USEPA guidance and current BAAQMD practices.
- 3.3** BAAQMD should develop a formal district-wide corrective action process.
- 3.4** BAAQMD should put in place a consistent record keeping process in which records are traceable and legally defensible.
- 3.5** The District should pursue development of technologies which can relieve workload burdens for station operators. Such technologies could include the streamlining of data logging, validation and storage and/or the wider use of the Internet to transfer and communicate data and information.
- 3.6** Continue to support the investigation into new methods, new pollutants and improved understanding of air quality when possible. The District is commended for their efforts.

Network Management

- 4.1** Continue to generate an Annual NAMS/SLAMS Report which includes data analysis and network assessment.
- 4.2** The District should relocate the San Jose 4th Street station as quickly as possible and within the vicinity of the current site, to continue monitoring the equivalent air mass.
- 4.3** Consider discontinuing the operation of the San Pablo site and selecting an alternative SO₂ NAMS site.
- 4.4** When reconstruction occurs, return the Los Gatos site to operation as soon as possible.
- 4.5** As part of a periodic assessment of the entire network, the District should consider terminating some CO monitoring in areas measuring well below the NAAQS.
- 4.6** As part of a periodic assessment of the entire network, the District could consider terminating some SO₂ monitoring in those areas reading well below the NAAQS.

Laboratory Activities

- 5.1** Develop and implement a laboratory QA Manual (or equivalent document) to cover all aspects of laboratory operations.
- 5.2** Assign an individual, other than the laboratory manager, to be responsible for laboratory quality assurance activities.
- 5.3** Define the laboratory corrective action process in the laboratory QA Manual (Laboratory Finding 5.1) and implement it.
- 5.4** Develop a laboratory record keeping procedure consistent with General Finding 3.4. Additionally, the laboratory should, immediately, add issuance dates and/or version numbers to all SOPs.
- 5.5** Develop an SOP for the laboratory data acquisition data base program.
- 5.6** EPA strongly recommends that control charts be used to monitor laboratory quality control checks.
- 5.7** A logbook should be established which tracks weigh room activities.
- 5.8** Set up a tracking system for laboratory supplies.
- 5.9** Set up a procedure for routinely documenting the laboratory sample storage freezer temperature.
- 5.10** The laboratory should adopt the OAQPS “PM2.5 Data Validation Template” and review their PM2.5 validation process to ensure consistency with this template.
- 5.11** Include the weight serial numbers, or other unique identifier, in each logbook entry.
- 5.12** Evaluate whether the shipping blocks can be cleaned. If aluminum contamination is found to be a source of sample contamination in the future, discontinue use of these blocks (antistatic bags can also be used for sample handling).
- 5.13** Compare the temperature loggers to a certified temperature standard at least annually. Record the temperatures logged for each shipment or provide sufficient documentation of studies that demonstrate that the criteria used for checking temperature loggers is adequate to preserve sample integrity.

- 5.14 Set a reasonable expiration date for the type of Po strips used.
- 5.15 Sample disposal should be recorded in a logbook.
- 5.16 The laboratory should consider an alternative storage space for filter archive. BAAQMD should develop options or additional storage for storing filters for over one year.
- 5.17 The laboratory should consider batching samples as a part of the QA process.
- 5.18 Explain weigh room temperature and relative humidity excursions on the strip charts and/or in a logbook.
- 5.19 Develop a more complete SOP based on the most recent guidance for PM10.
- 5.20 Based on PM10 guidance documents and good laboratory practices establish more rigorous QC checks for the PM10 weighing laboratory.
- 5.21 The laboratory must setup a schedule for certification of the PM10 weights.

Field Operations

- 6.1 Following reconstruction of the fire station at Los Gatos, ensure that the probe is made of glass or teflon its entire length.
- 6.2 Periodically review and evaluate the monitoring objectives and spatial scales for monitoring stations in the network. Attempt to resolve siting issues caused by nearby trees and buildings that obstruct air flow.
- 6.3 Standardize field SOPs and have operators become familiar with the methods.
- 6.4 Standardize the use of logbooks at all stations using legally defensible record-keeping practices.
- 6.5 The District should include installation, maintenance or changes affecting the manifold in the station logbook.
- 6.6 Whenever possible BAAQMD should start recording NOx data to be used for diagnostic purposes.

- 6.7 District management should support adequate or additional training for monitoring staff as needed: for new staff to learn correct air monitoring practices & methods and for experienced staff to stay abreast of new developments.
- 6.8 EPA will reflect the concerns to OAQPS for discussions for resolution under the national contract.
- 6.9 Log calibration gas cylinders in station logbook when installed at the site.

Data Management

- 7.1 EPA Region 9 should continue to support training on the new AIRS system during the startup period.

Quality Assurance Program

- 8.1 Review SOPs to ensure that they are consistent with current practices and updated as necessary.
- 8.2 Create a process to more widely distribute AQDAs and to implement more comprehensive follow-up and corrective actions when an AQDA is issued.
- 8.3 Centralize documentation of audit standard checks and document all cross checks performed.
- 8.4 Set up a formal audit reporting process which includes well-defined warning and control limits.
- 8.5 Create audit warning and control limits based on the federal criteria, and track audit results quarterly for compliance with the federal criteria.
- 8.6 Update the field audit SOPs.
- 8.7 Institute a policy that the field auditors bring verification of audit equipment certification into the field.
- 8.8 Institute a policy that auditors must document site visits and audits in the station logbooks.
- 8.9 The audit section supervisor has arranged to change the standard concentration blend to

extend to working life of the standard mix.

8.10 EPA Region 9 will forward NPAP concerns to our OAQPS counterparts

GLOSSARY OF ACRONYMS

ADT.....	Average Daily Traffic
AIRS.....	Aerometric Information Retrieval System
AQDA.....	Air Quality Data
BAAQMD.....	Bay Area Air Quality Management District
CO.....	Carbon Monoxide
CFR.....	Code of Federal Regulations
FEM.....	Federal Equivalent Method
FRM.....	Federal Reference Method
NAAQS.....	National Ambient Air Quality Standard
NAMS.....	National Air Monitoring Station
NPAP.....	National Performance Audit Program
NO ₂	Nitrogen Dioxide
NO _x	Nitrogen Oxides
OAQPS.....	Office of Air Quality Planning and Standards
O ₃	Ozone
PM.....	Particulate matter
PM _{2.5}	Particulate matter 2.5 microns or less in aerodynamic diameter
PM ₁₀	Particulate matter 10 microns or less in aerodynamic diameter
PC.....	Personal computer
PVC.....	Poly vinyl chloride
QA.....	Quality Assurance
QC.....	Quality Control
QAPP.....	Quality Assurance Project Plan
SPM.....	Special Purpose Monitor
SOP.....	Standard Operating Procedure
SLAMS.....	State or Local Air Monitoring Station
SO ₂	Sulfur Dioxide
TSA.....	Technical System Audit
U.S. EPA.....	United States Environmental Protection Agency